464XLAT: Breaking Free of IPv4

Cameron.Byrne@T-Mobile.com

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Background

- T-Mobile is a GSM / UMTS / LTE provider in the USA with 45+ Million subscribers

- In 2008, T-Mobile launched the first Android phone. This dramatically changed the mobile data dynamics – more devices, connected for a longer time, all needing IP addresses

- T-Mobile embraced the concept of IPv6-only, since dual-stack required IPv4 that was not available

- NAT64 / DNS64 was a good solution that did not require IPv4, but some applications failed to work on IPv6-only networks

Where are we right now?

- Published IETF RFC6877, 464XLAT

- 464XLAT implemented as a standard feature in Android 4.3 https://android.googlesource.com/platform/external/android-clat/

- 4 Android phones models launched as default 464XLAT, 2 million IPv6 subscribers as of December 2013

- No impact to existing IPv4 subscribers

- Simply:
  - Add IPv6 configuration and NAT64 / DNS64 network
  - Configure NEW phones to attach as IPv4 instead of IPv4

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Principles

- IPv6 can and must work in mobile networks
  - IPv4 cannot number the world
  - IPv6 is achievable and inexpensive
  - We are all stakeholders in IPv6 adoption
- Business and Technology Strategy for IPv6-only
  - Dual-stack does not solve the IPv4 number problem
  - 464XLAT is a final solution in mobile

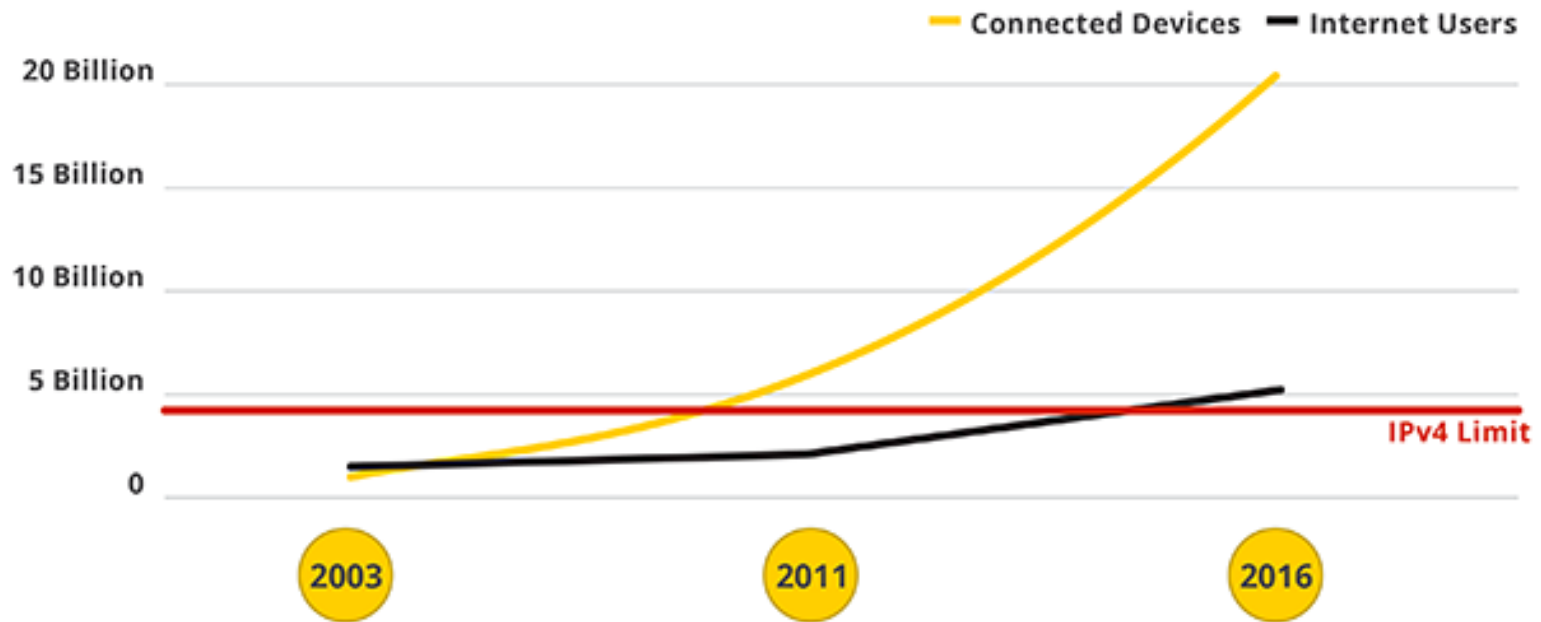# Default 464XLAT Phones at T-Mobile US

Samsung
Note 3

Samsung
Galaxy Light

Google / LG
Nexus 5

Samsung
Mega

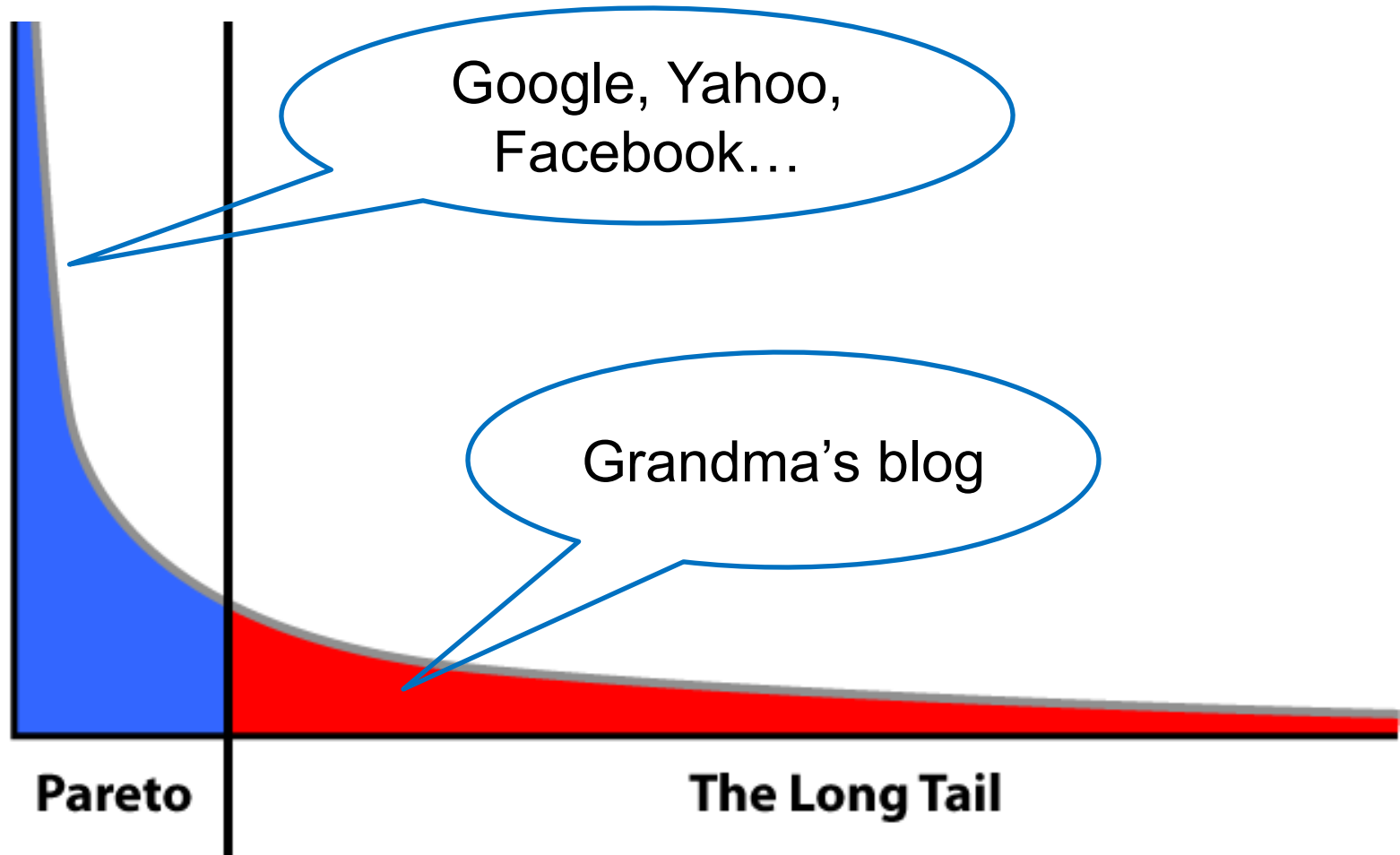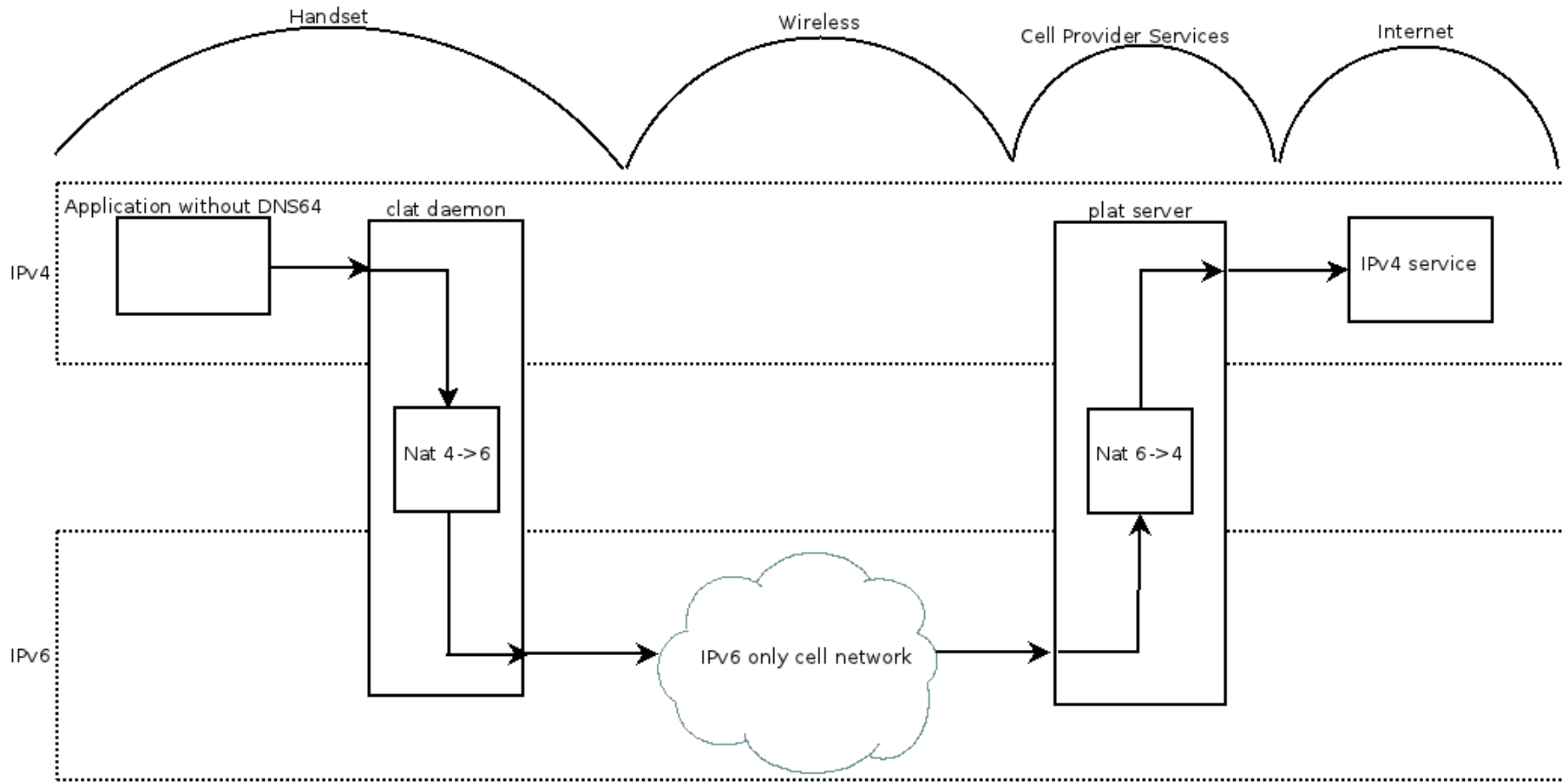# Simply more internet devices than internet addresses

http://www.google.com/intl/en/ipv6/

IPv4 does not fit today's business needs

- More internet devices than IPv4 numbers, ***private + public IPv4 is not enough***

- Growth rate of internet devices is very high

- RIPE and APNIC do not have IPv4

A few big fish make IPv6 possible

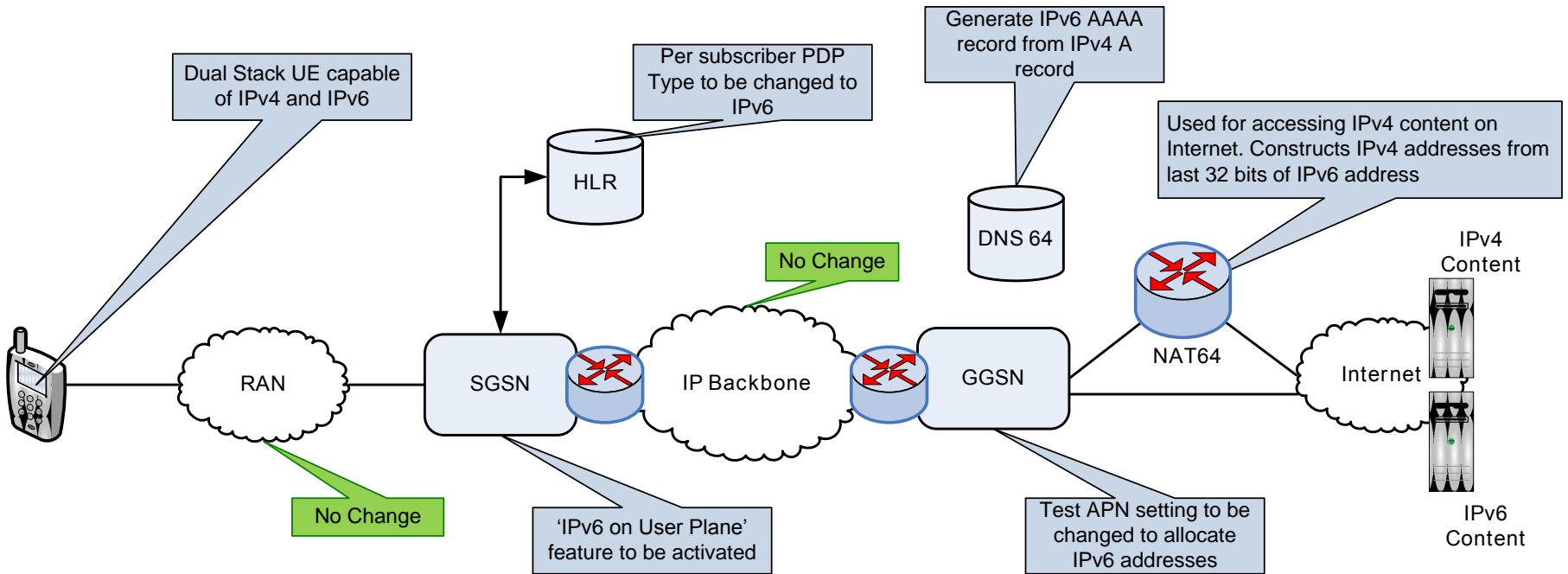# How to make EVERYTHING work on IPv6-only?

464XLAT allows for full functionality on IPv6-only network

- Dual-stack does not solve the IPv4 number scarcity issue

- IPv6-only + NAT64/DNS64 is very good, but not good enough for full IPv4 replacement (web and email work, but Skype does not work)

- IPv6-only + 464XLAT

  - Solves IPv4 numbering issue by not assigning IPv4 to edge nodes

  - Decouples edge growth from IPv4 availability

  - IPv4-only applications like Skype work on an IPv6-only network because 464XLAT translated IPv4 on the phone to IPv6 on the network

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Finally, IPv6 deployment is easy

- T-Mobile USA did not spend any CapEx on IPv6

- Introducing the feature to handsets is a slow and careful process, one *new* phone model at a time

- Innovative thinking helps reduce deployment costs (hash 128 bit numbers into 32 bit fields in billing records)

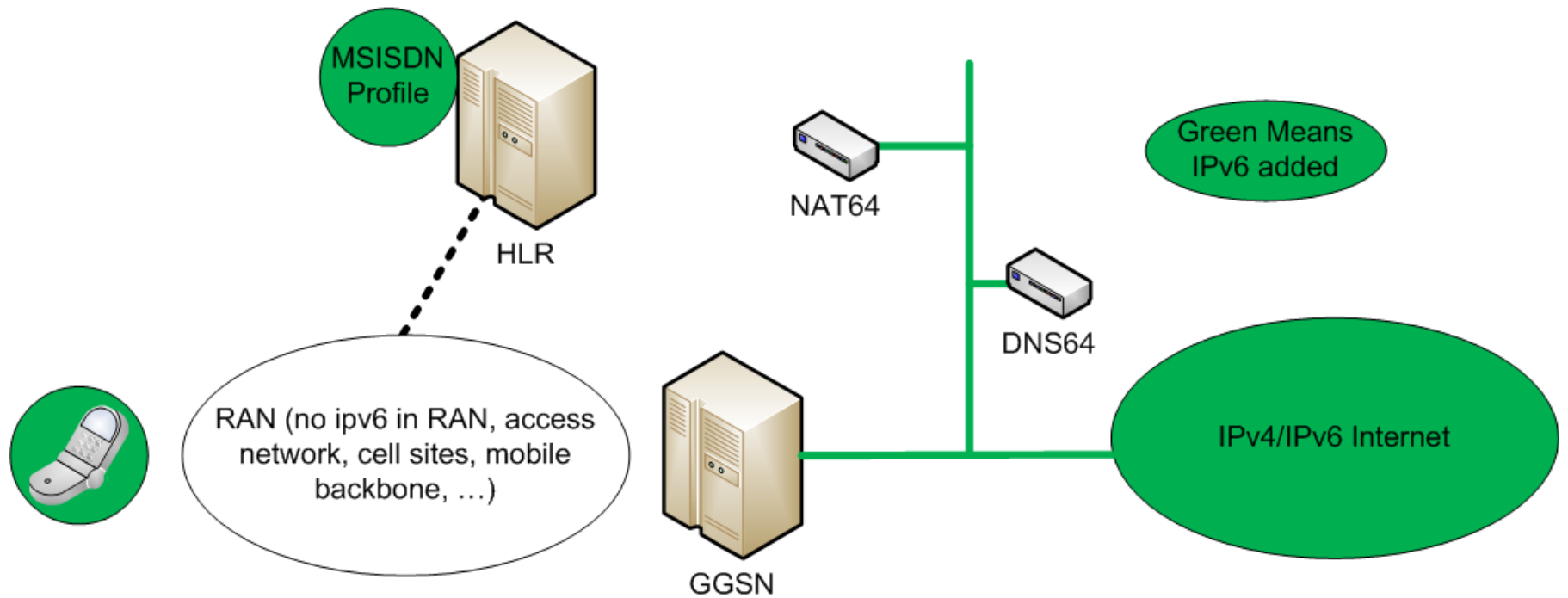- IPv6 will save money in your network (less NAT/CGN, no need to buy IPv4 addresses, …)

Impact to Network Entities

Dual Stack UE capable of IPv4 and IPv6

Per subscriber PDP Type to be changed to IPv6

Generate IPv6 AAAA record from IPv4 A record

Used for accessing IPv4 content on Internet. Constructs IPv4 addresses from last 32 bits of IPv6 address

HLR

DNS 64

No Change

RAN — SGSN — IP Backbone — GGSN — NAT64 — Internet

IPv4 Content

IPv6 Content

No Change

No Change

'IPv6 on User Plane' feature to be activated

Test APN setting to be changed to allocate IPv6 addresses

High Level View of IPv6 deployment:

Phone, HLR profile, GGSN, NAT64, IPv6 ISP

Summary of Conclusions

- IPv4 does not fit the business need

- IPv6 works today and is deployed on some the largest edge networks

- 464XLAT allows networks to grow without IPv4

- IPv6 deployment in 3GPP is easy

Big Picture: We must avoid the Internet's largest growth engine (mobile) from being indefinitely tied to scarce IPv4 and fragile stateful NAT44.